Method for washing laundry in a process-controlled household washing machine

[001] The invention relates to a method for washing laundry in a process-controlled household washing machine comprising a wash liquid container for receiving laundry and wash liquid intended for washing the laundry, wherein or whereon a heating device and a temperature sensor are attached, wherein water for washing is poured into the wash liquid container during a filling phase and the temperature sensor delivers signals for the respective temperature of the water or the wash liquid to the process control system during the washing phase and said process control system derives commands for controlling the heating device for heating the wash liquid from the temperature signals and wherein the washing process runs with a heating phase which begins with switching on the heating device and a post-wash phase at largely the same temperature, and lasts for a defined constant time from the beginning of switching on the heating device until the end of the post-wash phase.

[002] Washing machines of the type specified initially have been manufactured for many years by the proprietor of this patent and form a well-known prior art. The background for defining the duration of the washing process by specifying it from the beginning of the heating phase and the end of the post-wash phase is to ensure uniformly good washing results as a result of the time factor of the so-called Sinnersch cycle which prescribes a sum which is always the same for the factors temperature, time, mechanics and chemistry, remaining constant for the pure washing process.

[003] Now, however, under extreme conditions the temperature of the intake water is no longer within the postulated frame which assumes an inlet temperature of about 12°C. Fluctuations of ±3° are of little importance in this connection. Under extreme conditions, however, the predicted inlet temperature may specifically have deviated further downwards so that inlet temperatures of, for example, 5°C are possible. Then however, the heating phase is extended so significantly that the subsequent post-wash phase is too short because of the entire washing process being the same length. Then the mechanics factor has the same fraction but the temperature factor is reduced

because the temperature is too low over a large fraction of the washing process (in the heating phase).

[004] In order to remedy this and guarantee that the temperature factor always has the same fractions, EP 0 859 304 B1 has proposed that the input of thermal energy should be monitored and always kept the same under otherwise the same conditions.

[005] At the same time, for washing household laundry the laundry in a washing machine is washed in different program steps using a washing solution at varying temperature. For this purpose, the laundry is inserted in a laundry drum rotatably mounted in a wash liquid container and the washing solution (water with added cleansing agent) is supplied to the wash liquid container or the laundry drum. Different temperatures can be set in the washing program, usually ranging from tap water temperature (cold) up to 95°C for a boil wash. The washing machine has a heating device for heating the supplied water or the washing solution to the set temperature. Mechanical temperature sensors such as, for example, liquid expansion sensors or bimetallic sensors or electronic temperature sensors such as thermistors (NTC resistors) are arranged in the washing container to regulate the temperature of the washing solution.

[006] The known method for adjusting the temperature of the washing solution in the washing process provides that, as usual, the temperature of the washing solution is regulated between a maximum and a minimum value for a pre-defined regulating interval, during the regulation process the sum of the thermal energy supplied since the beginning of this regulating process should be determined continuously and the supply of thermal energy should be interrupted if the sum of the thermal energy supplied exceeds a pre-determined process energy value. These measures however no longer take into consideration the uniform duration of these regulated washing processes so that on the one hand the time factor can fluctuate and the rules of the Sinnersch cycle are no longer taken into account. This has the result that the cleaning effect is no longer uniformly good. On the other hand, the customer can no longer reckon on a total process duration of the same length for specific washing programs.

[007] It is thus the object of the invention to ensure that in the process described initially the influences of the temperature and time factors involved should be guaranteed if the temperature of the intaken water departs from the provided standard value.

[008] According to the invention, this object is solved by the temperature of the water or the wash liquid being determined at or after the end of the filling with water, that at a determined temperature of less than a standard value for the amount of water which has freshly run into the wash liquid container before the beginning of the washing process the heating device is switched on and that the beginning of the washing process is delayed by a defined time interval.

[009] Since the beginning of the washing process, that is so that the beginning of the guaranteed duration of the cleaning process for the laundry can be specified automatically depending on the initial temperature of the intaken water, the time duration for the cleaning process is determined independently of the initial temperature. It is thereby possible to adapt both the temperature factor, i.e. the quantity of input thermal energy and also the time factor to meet the requirements specified by the Sinnersch cycle. This also means maintaining the desired duration of washing processes under typical household conditions.

[010] If according to an advantageous further development of the method according to the invention, the temperature is first determined during the filling with water or wash liquid and before or during switching off the heating device, the duration of the washing process can be calculated with the highest accuracy.

[011] The standard value is best located in the range of 10°C to 15°C because the inlet temperature will regularly lie in this range. Under extreme conditions the inlet temperature can deviate substantially downwards, for example if the washing machine is located in a room subjected to large temperature fluctuations. After water having a temperature higher or lower than the standard value has been taken in, during the subsequent course of the filling process approximately uniformly temperature-controlled water (e.g. at 12°C) is passed through the cold or warm piping system

exposed in the room. However, the quantity of water which has run into the wash liquid container will have a mixing temperature which differs substantially (e.g. 12°C) from the standard value.

[012] At the same time, upward deviations tend to be unharmful for maintaining the cleaning effect even if as a result, the washing process is carried out with an overall slightly higher input of thermal energy with a constant effective washing time. Downward deviations will have no harmful effects as a result of postponing the beginning for the washing process because despite the washing solution beginning to act on the laundry at lower temperature and the heating phase thereby being lengthened, the duration of the effective washing process as a whole is maintained.

[013] According to an advantageous further development of the invention, the time interval can be defined by reaching the standard value. If the inlet temperature should lie below the standard value, it is possible to precisely set the beginning of the washing process by beginning the heating phase by switching on the heating device and waiting until the temperature of the washing solution has reached the standard value (e.g. 12°C). The beginning of the washing process is only defined at this time so that after a pre-determined time has elapsed from this time, the post-wash phase is ended for example by pumping away the washing solution or by adding further unheated water (cool down) to the wash liquid container.

[014] In another variant for an advantageous further development of the invention, a pre-defined length is set for the duration of the postponement of the beginning of the washing process. It can be assumed that the deviations of the inlet temperature from the standard value rarely have extreme values or fluctuate substantially and a standard deviation is thus specified which is always assumed when the determined inlet temperature deviates downwards by a pre-determined value from the standard value. The value of this deviation can be 3° for example. If this deviation is achieved or exceeded, a fixed pre-determined time interval is inserted for the postponement of the beginning of the washing process. If the total input of thermal energy and time is then too great, the cleaning effect will at least not become inferior to that desired. On the

other hand, a loss for those factors caused by a too-short postponement if the actual inlet temperature should be lower than that corresponding to the pre-determined time interval for the displacement, is only very small and the resulting reduction in the cleaning effect would probably no longer be measurable.

[015] The inventive method is explained hereinafter with reference to two diagrams shown in the drawings. In the drawings

[016] Fig. 1 shows a temperature profile of the washing solution as a function of the time after a water intake with typical inlet temperature (standard value) and

[017] Fig. 2 shows a temperature profile compared with that in Fig. 1 after a water intake with an inlet temperature below the standard value.

[018] The temperature profile during washing programs in a washing machine is typically as shown in Fig. 1. At time 0 the washing program begins with an intake of unheated water, for example, from a domestic water supply. The incoming water has a temperature according to a standard value S assumed for this example, namely 15°C. It is further assumed for simplification purposes that the filling phase F is completed at time t_{0S}. A water level sensor not described in further detail can now, for example, cause the closure of a switch in the circuit of the heating device. As a result, the continuous heating of the washing solution (the water which has flowed in has entrained washing agent from a flushing container) begins until the target value for the set washing temperature (e.g. 60°C) is reached. The heating device is then switched off again and the washing solution cools downs to a value below the target temperature, e.g. 50°C, by the end of the washing process W which is substantially characterised by the introduction of mechanics as a result of rotations of the drum at intervals. The end of the washing process W is determined by a fixed time interval $t_{ES} - t_{0S}$ which is stored in the washing program and a further supply of unheated water is initiated at time t_{ES} whereby a cooling phase (so-called cool down) and the rinsing phase R begins.

[019] If the temperature of the inflowing water differs only slightly from the standard value $S = 15°C$, e.g. by only 3°, the washing process is operated further according to the profile shown in the diagram in Fig. 1. This means that although the initial temperature is now slightly lower than typical, the washing process W now begins with a lower temperature so that the heating phase $t_{1S} - t_{0S}$ now takes a longer time than when beginning at 15°C, which time is now lost to part of the washing process W wherein the washing solution cools down again until the end t_{ES}. This guarantees that the time factor is observed. However, the time interval within the washing process W in which the laundry is washed with a temperature of the washing solution at least in the vicinity of the target temperature is shortened compared with the typical profile shown.

[020] Figure 2 shows an example wherein considerably cooler water (e.g. only 6°C warm water) flows in at the beginning of a washing program. For comparison with the typical profile, the curve from Fig. 1 is also plotted as thin lines. Here the heating naturally also begins after the end of the filling phase F. Unlike in the typical profile however, the beginning of heating does not coincide with the beginning of the washing phase W. Rather, a delay phase D is switched on here which, as in the example shown, can either last until the temperature of the washing solution being heated has reached the standard value S or has a pre-determined duration which is approximately of similar length to the duration shown in the example.

[021] At the end of the delay phase D, however, the washing process W begins again with a pre-determined time interval $t_{EK} - t_{0K}$ which is the same length as $t_{ES} - t_{0S}$. This ensures that in any case of the inlet temperature in the washing process, the time factor cannot be too short.

[022]